REPORT DOCUMENTATION PAGE

FORM APPROVED
OMB No. 0704-0188

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	November 26, 2002	Performance (Technical)

4. TITLE AND SUBTITLE OF REPORT

Nurturing ECSU Research Talent Technical Report

5. FUNDING NUMBERS

N000149910990
N000149810749

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7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

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8. PERFORMING ORGANIZATION REPORT NUMBER:

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

Office of Naval Research

10. SPONSORING/MONITORING AGENCY REPORT NUMBER:

11. SUPPLEMENTARY NOTES:

12a. DISTRIBUTION AVAILABILITY STATEMENT

unlimited

12b. DISTRIBUTION CODE

13. ABSTRACT (Maximum 200 words)

Report contains program highlights and summer 2002 Research Abstracts.

14. SUBJECT TERMS	15. NUMBER OF PAGES:
	16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT:	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT

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NURTURING ECSU RESEARCH TALENT ELIZABETH CITY STATE UNIVERSITY

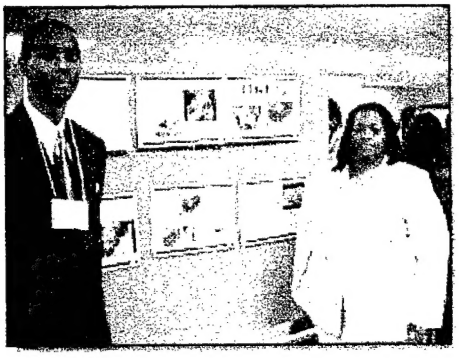
PROGRAM HIGHLIGHTS AND SUMMER 2002 RESEARCH ABSTRACTS

Ramatoulie Bah

Mentor: Dr. Jackie Krim, Professor
Internship: REU in Physics, North Carolina State University
Title: Quartz Crystal Oscillations in Liquids: Quantitative Comparison of Theory and Experiment

Even though numerous experiments have been done on dipping Quartz Crystal Microbalance (QCM's) in liquids, experimental results still vary from the stated theory. This theory, which was developed by Kanazawa and co-workers, stated that quartz crystals do oscillate in a stable manner when they come into contact with liquids, and the frequency shift is equal to a certain formula.

In this experiment, a Quartz Crystal was used in the determination of frequency shift when immersed into liquids and when in contact with one surface of the QCM relative to air. The quartz crystal, which oscillates at its resonant frequency, is dipped into liquid, and as it comes into contact with the liquid, the overall stability was reduced, yielding a frequency shift. Of concern here was the development of a relation between measured frequency shift values (after the QCM has come into contact with the liquid) and theoretical values. My experimental results do not necessarily tally with theoretical values.



Shayla Brooks

Mentor: Dr. Ernest Stitzinger
Internship: North Carolina State University, Raleigh, NC
Title: An Investigation of Cryptography: Methods for Encryption and Decryption of Secret Messages

Cryptography is the study of techniques that can be used to disguise a message so that only the intended recipient can remove the disguise and read it. The investigator has explored cryptography and mathematical operations used to solve various cryptosystems. Some specific methods of cryptography were researched such as the Hill Cryptosystem for which the Hill Encryption Method and the generalized Hill Encryption Method were used. In addition, the investigator examined the RSA Cryptosystem and RSA encryption and decryption. Within the topic of the RSA cryptosystem subtopics such as, modular exponentiation, primality testing, integer factorization, and digital signatures were discussed. Furthermore, there was use of the ElGamal Cryptosystem and a new cryptosystem called the Chinese Remainder Theorem (CRT) in this project. Actual examples of these methods were illustrated by

written exercises from the book entitled, Applications of Abstract Algebra with MAPLE. MAPLE software was integrated into the project to illustrate the enciphering and deciphering of messages using the various methods, and the investigator received hands-on practice with MAPLE from the written exercises in the text. Ultimately, this experiment has proven that there are various methods of solving cryptographic problems, by investigating a variety of cryptosystems and how they are used.

Dana Brown

Mentor: Jerry Leete
Internship: Elizabeth City State University
Title: Water Quality Investigation involving the Dismal Swamp, Boardwalk, and the Pasquotank River

The Dismal Swamp is one of the largest swamps in the United States covering approximately 750 square miles that encompass northeastern North Carolina and southeastern Virginia. Some of its wildlife includes bears, snakes, foxes, turtles and a variety of birds. The Dismal Swamp is also home to many types of plants and trees, such as the bald cypress, black gum, and white cedar trees. The purpose of this Dismal Swamp Internship project was to collect some of this vegetation and document it. Besides collecting leaves and labeling some of the trees, we also collected some of the insects that live in the swamp. All of our collections were strictly done at only the sites of the Dismal Swamp and the Boardwalk, which is ECSU owned and located on a Naval Base in Chesapeake, VA. The project also called for the monitoring of water quality in the swamp and other water sites near the swamp. The two areas my part of the project dealt with were the sites of the College of the Albemarle (COA) in Elizabeth City, NC and a boat ramp in Old Trap, NC. While using special instruments, from these sites temperature, conductivity, salinity, ph, dissolved oxygen, and humidity were documented. Using this information graphs were composed using Microsoft Excel and the information was given to the Department of Geological and Environmental Science at Elizabeth City State University to use for further research in their Boardwalk Hydrology Project.

Linwood Creekmore

Mentors: JaeTae Seo, Qiguang Yang, Santiel Creekmore
Internship: Department of Physics, Hampton University
Title: CdSe Semiconductor Nanomaterial Synthesis and Nonlinear Optical Spectroscopy for Optical Power Limiting Applications

The nonlinear optical properties of CdSe nanocrystals have been determined by Z-scan technique at 800nm. The sizes of nanocrystals were estimated by the band-gap shifts in the absorption spectrum. In this paper, we determine the nonlinear refractive coefficient (g) and the Two-Photon Absorption (TPA) coefficient (b). CdSe nanocrystals in toluene were produced physically by ball milling.

Torreon N. Creekmore

Mentor: Timothy Berkoff, Dr. Judd Welton, and V. Stanley Scott
Internship: GSFC Howard University, Washington, D.C.
Title: New Generation Micro-Pulse LIDAR (MPL): MPL-4

Light Detection and Ranging (LIDAR) is a power tool for understanding and studying the Earth's atmosphere. The use of lasers in remote sensing helps scientists to take advantage of the unique attributes of laser light to measure properties of the Earth's atmosphere. A typical LIDAR consists mainly of a laser, telescope receiver, detector, and a computer data analysis system. Most LIDARs use high powered laser systems and are not eye safe. With the advent of new compact eye safe LIDAR; known as

Micro-Pulse LIDAR (MPL), scientists now have new capabilities to measure cloud and aerosol structures. Micro-Pulse LIDARs are different that traditional LIDARs in that they use a high repetition-rate laser at low pulse energies. And laser beam expansion to achieve eye-safe operation. A new generation type Micro-Pulse LIDAR called "MPL-4" was characterized and evaluated for use in full-time field monitoring. The new system incorporated a ruggedized telescope, new laser supply and data system, and fiber-coupled detection to improve performance and reliability. Comparisons of the MPL data with data from other systems were performed to show that the MPL-4 could produce accurate profiles of cloud and aerosol properties. LIDAR systems are used to profile atmospheric cloud and aerosol layers. The intended applications are measurements of the cloud and aerosol structures. This MPL system is the first of many to be deployed globally to replace older versions of the instrument in the worldwide network of MPL systems called Micro-Pulse LIDAR Network (MPL-Net). The primary goal of MPL-net is to provide long-term data sets of cloud and aerosol vertical distributions at key sites around the world, which will help validate and improve global and regional climate models and also serve as ground-truth sites for NASA/EOS satellite programs.

Vincent Augustus Davis, Jr.

Mentor: Enectali Figueroa-Feliciano, Ph.D.
Internship: Summer Institute in Engineering and Computer Applications Program, NASA/GSFC, Code 662 X-Ray Astrophysics Branch
Title: Microcalorimeters in Astro-E2 and Constellation-X

The study of astronomical objects at a high energy of X-rays began in the early 1960's. Until then, scientists and astronomers knew only that the Sun was a concentrated source in this waveband. The Earth's atmosphere absorbs most X-rays, so rocket flights became necessary. Over the past 35 years, X-ray astronomy has grown and is now a vital tool in the cutting edge of astrophysical research. X-ray observations reveal some of the most energetic phenomena in the Universe. They provide probes that can investigate atomic and nuclear processes. This area of astronomy is very important for the study of some of the unanswered questions involving dark matter, black holes, supernovae and other phenomena with high temperatures or explosions. The Laboratory of High Energy Astrophysics (LHEA), of NASA's Goddard Space Flight Center (GSFC), is concerned with measuring X-rays from astronomical objects. This will be done with the aid of microcalorimeters. A microcalorimeter is a thermal device that operates by measuring the energy of an X-ray. It consists of an absorber to take in X-ray photons, a thermometer to measure the resulting temperature rise, and a weak link to a low temperature heat sink that provides thermal isolation needed to sense a temperature change. These microcalorimeters will be utilized in two space missions; Astro-E2 and the Constellation-X Observatory. There will be two objectives for this research project. With the aid of Igor Pro Version 4.0, the data analysis section will be to run a program that will fit lines for the X-ray Spectrometer (XRS) detector for Astro-E2. The hardware section calls for a design for a Superconducting Stepper Motor X-ray Shutter that will be part of the Constellation-X test system. This shutter will control the flow of X-ray photons to the detector.

Danielle Graves

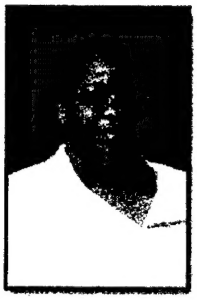
Mentor: Falcon Rankins
Internship: UnIPhy-REU Program, Hampton University, Hampton, VA
Title: The Analysis of Fuel Optimal Periodic Trajectories

In this research, conventional aircraft were flown on periodic cruise trajectories using an optimization program to determine if flying periodically is more fuel efficient than flying steady state. This research also included the development of an analysis package

using MATLAB. The analysis package was used to carefully examine the results from the optimization program.

Paula Harrell & Rodney Stewart

Mentors: Dr. Linda Hayden, Dr. Francisco San Juan, Ernest Walker, III
Internship: URE in Ocean and Marine Science, ECSU
Title: 2002 Fisheries Stock Assessment



The 2002 Fisheries Stock Assessment Research Team will document the installation of the TeraScan hardware and software in Dixon Hall on the campus of Elizabeth City State University. The Team will also present models and proposed solutions fish stock learned at the Fisheries Stock Assessment at Jackson State University.

TeraScan is an integrated system of hardware and software, which is designed to automatically capture data from meteorological and environmental satellites and process the data into image and overlay products. Data and products can then be viewed on the TeraScan system. They can also be distributed to a number of local or off-site destinations across the network.

The TeraScan will capture and process as AVHRR data from the NOAA satellites, Imager and Sounder data from the GOES geostationary satellites, SeaWiFS data from the OrbView-2 satellite, Imager data from the FY1-C satellite and Landsat MSS, Landsat TM, MOS MESSR, MOS VTIR, and SAR.

The Team will also present information and findings discovered from the Program Development and Enhancement in Fisheries Stock Assessment at Jackson State University. This includes multi-formula modeling utilizing the Ricker, Schaefer, and Von Bertalanffy formulae, age determination and yield-per-recruit and spawning biomass per recruit, and full age structure models. The Team will also discuss stock assessment such as tagging and marking of stock.

Golar Newby

Mentor: Ray Gilstrap
Internship: NASA Ames
Title: Quality of Service Networking Utilizing Protective Preferential Treatment over a Gigabit Ethernet Environment

A war is being waged within homes, university campus, libraries, government buildings and many other places that appear to be peaceful. The soldiers of this war are highly evolved computer systems, the battlegrounds are aging network environments, and the prize of the war is bandwidth. Computers have grown more powerful from year to year, but networking environments have been hard paced to keep up with the evolutionary changes of CPUs. With the high volume of customers, students, employees and other users that rely on consistent network services; administrators have been plagued with bandwidth woes. Solutions to bandwidth problems are not easy generated or implemented, but by looking at different degrees of network reliability, weakness in current internet protocols, makeup of IP packets and the different transport protocols better understanding of how networks allocate resources can be achieved. Developing quality of service for a particular network environment depends on that individual network, but by implementing preferential treatment to a particular type of network traffic that specified traffic flow could be protected from other programs seeking a higher bandwidth. The research conducted at NASA Ames utilized Gigabit Ethernet connections on two Solaris workstations, a Cisco 7500 router, a Cisco 7206 VXR router, a PCMon system, and a Fast Ethernet connection between another Solaris workstation, the PCMon system, and the two routers. The research conducted was to see weather an isolated flow of data could be protected and guaranteed a specific bandwidth without any regards to other traffic on the network.

Elizabeth Rascoe

Mentor: Helen Woodland
Internship: Federal Aviation Administration
Title: ICE-MAN Project

During the course of the 2001-2002 school year, I was contacted and asked to return to the Federal Aviation Administration to intern for the summer. Upon my arrival, the ICE-MAN (Integrated Computing Environment Mainframe and Network) team traveled to Atlantic City, New Jersey for annual technical conference. There we brainstormed ways to improve customer service and maintain customer's confidence in the life expectancy of ICE-MAN. I was able to offer the suggestion of creating a customer profile for each one that shows their interests and needs for their business and what they would like to see from ICE-MAN. This suggestion became my summer project along with other duties within the office. Overall, I enjoyed my summer in Washington, DC and would recommend the experience to everyone.

Carl W. Seward

Mentor: Dr. Kenneth W. McFarlane
Internship: UnIPhy-REU Program, Hampton University, Hampton, VA
Title: Working on A Toroidal Large Hadron Collider Apparatus Transition Radiation Tracker (ATLAS TRT) Experiment

In our research, we addressed the performance and reliability of the ATLAS Transition Radiation Tracker (TRT). The ATLAS TRT is a new scientific instrument designed to detect and measure particles in the ATLAS Experiment at the Large Hadron Collider (LHC) at CERN. The TRT will be installed in the center of ATLAS and will be inaccessible for at least the scheduled ten years that the experiment will run; therefore, reliable performance is crucial. The research performed was aimed at ensuring high reliability of the TRT through mapping the locations of straws in the three TRT modules, and evaluation of long-term stability of sense wire tension for wires to be placed in modules of the TRT, and an assessment of linearity test electronics. Quality control will be done by looking for gain variation along the wires. Gain variation measurements will be done with electronic systems through testing and calibration of critical components of this system. Research performed determined that the components did not perform as well as expected and corrections will be needed for the actual tests.

Eunice Smith

Mentor:
Internship: Purdue University, W. Lafayette, IN
Title: Web Page Development for the ECE Graduate Program

The internet, which began in 1969, is among the greatest findings of the twentieth century. It has grown from four host computer systems to tens of millions. What is so remarkable about this very useful tool is that no one owns it and it is available to anyone who can afford it. The internet can be a tool for education, motivation, information, persuasion, sales, or advertisement.

We explored using the internet as a tool for education by investigating web page development. The Electrical and Computer Engineering Graduate Program is the largest graduate program on Purdue University's campus with an annual enrollment of about 500 students, which is one/fifth of the total graduate student population at the university. The program is comprised of students from not only across the country, but also from around the world. Because of this, the internet plays a vital role in transferring information to anyone.

In this paper, we report our results produced from investigating web development using a very important language called Hyper Text Markup Language (HTML). HTML is identified as a markup language because it tells a computer how a page should be formatted. By exploring this language, we were able to assist in easing the transfer of information from the ECE Graduate Program to their students.

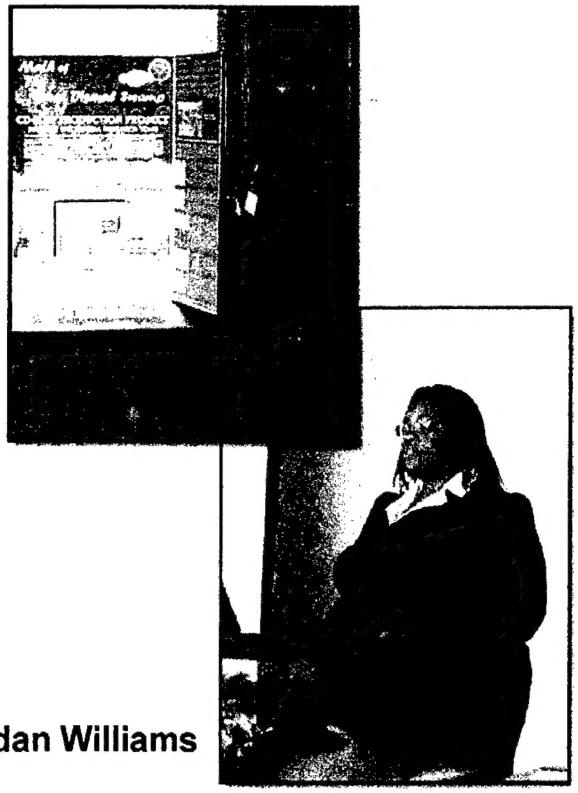
Nelson Veale

Mentor: Dr. Guoqing Tang, Dr. Dominis P. Clemence, Dr. Caesar R. Jackson
Internship: North Carolina A&T University, Greensboro, North Carolina
Title: Forward Finite Difference Modeling of Seismic Wave Propagation

There has been a concentrated effort in the use of numerical modeling to create synthetic seismograms. Geophysicists, mathematicians, and computer specialists have made a collective effort to create accurate models to refine the method used to analyze geophysical phenomena. A simple and accurate approach to this challenge is finite difference representation. This method uses numerous discrete solutions to the second order acoustic or elastic wave equations in homogenous or heterogeneous regions to simulate seismic wave propagation through acoustic or elastic media.

In this project we investigated these finite difference methods and presented an analysis of a model based on actual subsurface structure findings obtained from geophysical surveys at North Carolina A&T State University Environmental Study Site using seismic refraction technique. The model used consisted of two distinct layers with different velocities. Both velocity and density in each layer were assumed to be constant. The study of this numerical modeling problem focused on:

• Determining:
(a) appropriate boundary conditions
(b) a reasonable source function that resembles the actual source wavelet generated through swinging a sledgehammer
(c) Critical offsets beyond which we expected the occurrence of head waves
• Discretizing the partial differential equation representing our model using three-point central difference approximations to convert the PDE into an explicit iterative difference equation
• Developing a Maple computer program to solve the PDE numerically and plot the numerical solution
• Interpreting the obtained synthetic seismic data



Jordan Williams

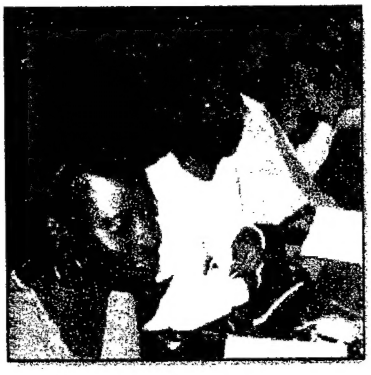
Mentors:
Dr. Champion Deivanayagam, Dr. Larry Delucus, Dr. H. Banergee
Internship: University of Alabama
Title: Crystallography

The Purpose of my stay at the University of Alabama (UAB) was to learn how to grow protein crystals. Crystallography is the study of crystals; whose molecules are arranged in a symmetrical manner. There are two components of symmetry, namely rotation and translation, through which molecules can be symmetrically arranged in 236 different ways in three dimensional space. Some popular examples of crystals are quarts, diamonds, and gem stones. Nobody knows how crystals formed and the basis of crystal nucleation still remains an unanswered question.

My job was to help purify and grow crystals of HBHA (Heparin Binding Hemaagluttinin) that is present on the surface of Mycrobacterium Tuberculosis. Near to a 100% purity is a prerequisite for crystal growth and hence purification plays an important role in crystallization. The HBHA harboring E. Coli cells were used to mass-produce the protein in large quantities.

Photo Highlights

The Office of Naval Research Nurturing ECSU Research Talent program involves undergraduate mathematics and computer science majors in academic year team research activities. Research and training meetings began in early September and are held every Tuesday and Thursday 5-8 PM through mid April. Research meetings start with a 20-30 minute announcement period during which time students learn about internship opportunities, hear program announcements, give team reports, discuss travel logistics, and discuss goals of the program.Following the announcement period, students meet with faculty mentors or attend training on tools used for research. In addition, students spend 20 hrs/week in the undergraduate research computer laboratory completing task sheet requirements and research assignments. The closing program is held on two nights in April. During the closing program, students make oral presentations of their research activities. The research teams are also required to complete written reports and to maintain a team web page.



2002-2003 Research Teams

Remote Sensing
Mentor: Mrs. Sharon Brown
Researchers: Willie Brown Jr., Eric Jones Jr., Leonda Moore, Karitsa Williams, Jovan Griffin

GLOBE
Mentor: Mr. Ervin Howard
Researchers: Dana Brown, Elizabeth Rascoe, Carl Seward, Shawneque Reid, Anesia Williams

Networking
Mentors: Mr. Chris Edwards, Mr. Joseph Gale
Researchers: Golar Newby, Paula Harrell, Danielle Graves, Rodney Stewart

Multimedia
Mentor: Mr. Jeff Wood
Researchers: Shayla Brooks, Willie Gilchrist, II, Nelson Veale

UNIX
Mentors: Dr. Linda Hayden, Mr. Benjamin James, III
Researchers: Eunice Smith, Ramatoulie Bah, Linwood Creekmore, Vincent Davis, Torreon Creekmore

Dates to Remember

Internship Roundtable
3:30 pm 116 LH November 21, 2002

GA Tech Focus
January 16-19, 2003

Black Creativity 2003
February 1, 2003

NOAA
Expanding Opportunities Conference
March 30 – April 1, 2003

Final Oral Reports
April 8, 10, 2003

URE in Ocean and Marine Science
May 27 – July 19, 2003

ADMI Conference
May 30 – June 1, 2003

Earth System Science Academy
June 13-14, 2003

IGARSS Conference
July 21-26, 2003

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For more information visit our website at:
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Grant # N00014-98-1-0749
Grant # N00014-99-1-0990